

REMARKS

Claims 86-88, 90-162, 224-227, 270-272 and 287 are pending in the subject application. Claims 140-150, 159-162, 224-227 and 270 have been withdrawn from consideration. In the Office Action, claims 86-88, 90-139, 151-158, 271, 272, and 287 stand rejected. Specifically, claim 287 stands rejected under 35 U.S.C. § 112, second paragraph. Claims 86-88, 90-139, and 287 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent Nos. 5,945,491 or 6,111,022 to Matyjaszewski et al. (“the ‘491 patent” and “the ‘022 patent”, respectively). In addition, claims 151-158 and 271-272 stand rejected under 35 U.S.C. § 103(a) as being obvious over the ‘491 patent in view of Patten et al., “Atom Transfer Radical Polymerization and the Synthesis of Polymeric Materials,” *Adv. Mat.*, 1998, 10(12), 901-915 (“Patten”). Applicants traverse these rejections as set forth herein.

In the present response, claims 86, 90, 94, 95, 97, 99, 100, 102, 105, 107-110, 114, 118, 120, 122-125, 130, 131, 134, 137, 151, and 154-158 have been amended. Claims 88, 93, 153, 271-272, and 287 have been canceled. New claim 289 is added. Applicants expressly reserve the right to pursue the subject matter of any canceled, amended or withdrawn claim at a future date via a continuation or divisional type application.

Claims 94, 97, 99, 100, 105, 114, 122-124, 130, 131, 134, 137, and 154-158 have been amended to correct minor errors due to typographical mistakes, correct dependencies due to canceled claims, to provide proper antecedent basis, or to clarify the claimed subject matter. Claims 86, 90, 95, 102, 107-110, 118, 120, 125, and 151 have been amended to more clearly set forth the subject matter claimed. Support for these amendments may be found throughout the specification as originally filed. For example, support for amendments to claims 86, 90, 95, 102, 107-110, 118, 120, and 125 may be found, at least, on page 23, line 16 to page 28, line 11; page 28, line 31 to page 34, line 13; Figures 6 and 7; and Examples 14, 15, and 34 of the application as filed. Claim 151 has been amended to incorporate the elements of claim 153. Support for these amendments may at least be found in claim 153; page 35, line 1 to page 36, line 14; Scheme 5; and Examples 30, 31, and 33. No new matter has been added by these amendments.

New claim 289 more clearly describes the subject matter of canceled claim 271. Support for the subject matter of this new claim may at least be found on page 38, lines 3-17, scheme 6, and original claim 271.

Rejection under 35 U.S.C. § 112, Second Paragraph

Claims 287 stands rejected under 35 U.S.C. § 112, second paragraph as being indefinite. In the present response claim 287 has been canceled, thereby making the rejection moot. Applicants respectfully request withdrawal of the rejection.

Rejection under 35 U.S.C. § 102(e)

Claims 86-88, 90-139, 287 and 288 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent Nos. 5,945,491 (the '491 patent) or 6,111,022 (the '022 patent) to Matyjaszewski et al. (collectively, "the Matyjaszewski patents"). Applicants respectfully traverse this rejection for the reasons set forth herein.

The Matyjaszewski patents disclose a controlled atom transfer radical polymerization ("ATRP") process to form polymers having defined structure. The polymers are synthesized by the controlled addition of radically polymerizable monomers to the growing end of the polymer chain by a reversible redox process through which a radically transferable group transfers between the growing polymer chain (dormant stage) and the catalyst. (See, for example, the '491 patent at column 7, line 51 to column 8, line 28). The Matyjaszewski patents disclose a method for transforming a living carbocationic polymerization or polyesterification into a living radical polymerization. (See, for example, the '491 patent at column 15, line 15 to column 20, line 31). The Matyjaszewski patents also disclose the synthesis of hyperbranched polymers using AB₂ monomers having an olefin and a halide. (See, for example, the '491 patent at column 22, line 33 to column 24, line 25). The hyperbranched polymers are formed by sequentially adding AB₂ monomers to the growing polymer through activation of the halide group by the atom transfer process. (See, for example, the '491 patent at Scheme 5, column 23).

In contrast, independent claims 86, 107, and 118 and the claims dependent therefrom describe a new process for the synthesis of macromonomers having

functionality that can be used in subsequent polymerization processes. According to this process, a first oligomer or polymer from an atom transfer radical polymerization is reacted with an unsaturated second compound (or coupling compound in claim 118) having a first desired functional group (which can be an α,α -disubstituted olefin group having α -substituent groups), wherein the second compound is added to the oligomer or polymer via an atom transfer process to form a second oligomer or polymer having the first desired functional group and the radically transferable atom or group, where the second oligomer or polymer is not reactive to the catalyst. The second oligomer or polymer is not reactive to the catalyst because the functional group or α -substituent groups on the second compound do not activate the second oligomer or polymer to further ATRP polymerization.

Unlike the processes described in the Matyjaszewski patents, since the second oligomer or polymer having the radically transferable atom or group cannot undergo subsequent ATRP chain elongation, the polymerization is stopped. Further, as described in claims 90, 107, and 118, the second oligomer or polymer having the radically transferable atom or group can undergo an elimination reaction, losing the radically transferable atom or group and a β -hydrogen to form a reactive unsaturated group. The resulting oligomer or polymer with a reactive unsaturated group may function as a macromonomer. These features are not described in the Matyjaszewski patents, since all polymers in those references are activated to undergo subsequent atom transfer radical polymerization.

The Office maintains the argument that the Matyjaszewski patents disclose non-radically polymerizable monomers at structure (V) and column 31, Table 5 of the '491 patent. Applicants argue that structure (V) describes AB₂ monomers having both an olefin and a halogen (see column 22, lines 32-64) and cannot be a methyl vinyl ketone as maintained by the Office since it is required to have both a halogen on the A group and an organic spacer group R₂⁴ between the olefin and the A group. With reference to the Office's assertion that Table 5 discloses methyl vinyl ketone as a monomer, Applicants respectfully direct the Office's attention to the Certificates of Corrections attached to each of the '491 patent and the '022 patent wherein the structures in Table 5 have been corrected to show methyl acrylate (Exp 3) and methyl methacrylate (Exp 4).

According to the Patent Law, “[s]uch patent, together with the certificate, shall have the same effect and operation in law on the trial of actions for causes thereafter arising as if the same had been originally issued in such corrected form.” (35 U.S.C. § 255). Thus, the Matyjaszewski patents do not disclose the use of a non-radically polymerizable monomer in an ATRP process.

The Matyjaszewski patents do not teach or disclose adding a second compound to the polymerization where the resulting second oligomer or polymer is not reactive to the catalyst. In contrast, all of the polymerizations disclosed in the Matyjaszewski patents form an oligomer or polymer to which subsequent monomers may be added by an ATRP process. Therefore, the Matyjaszewski patents do not teach or disclose each and every element of claims 89, 107 and 118 and the claims dependent therefrom. Therefore, Applicants respectfully request withdrawal of the rejection under 35 U.S.C. § 102(e).

Rejections under 35 U.S.C. § 103(a)

Claims 151-158 and 271-272 stand rejected under 35 U.S.C. § 103(a) as being obvious over the '491 patent in view of Patten et al., "Atom Transfer Radical Polymerization and the Synthesis of Polymeric Materials," *Adv. Mat.*, 1998, 10(12), 901-915 ("Patten"). Claims 271 and 272 have been canceled and Applicants traverse the rejection of claims 151-158 for the reasons set forth herein.

The Office maintains that the claimed process differs from the '491 patent as lacking a core forming compound or multi-armed star copolymers. The Office states that Patten discloses a core forming compound and that multi-armed star copolymers can be prepared by ATRP.

As set forth in Applicant's previous responses, claims 151-158 of the subject application describe an "arm-first" approach to the synthesis of a multi-arm star copolymer (i.e., reacting polymer chains having a radically transferable atom or group with the core forming compound); whereas the cited references, at best, disclose a step-wise approach to star copolymers using an AB₂-type monomer. Neither the Matyjaszewski patents nor the Patten reference teach or disclose an "arm-first" synthesis of a multi-arm star copolymer using a divinyl core forming compound.

The Office states that Patten discloses a core forming compound. However, the compound used in the Patten hyperbranched polymer synthesis is an AB₂ type monomer and not a divinyl core forming compound. (See, Patten, Scheme 6, page 913). Patten does not disclose or suggest adding a divinyl core forming compound to an active atom transfer radical polymerization process to form a multi-arm star copolymer via an arm-first approach as required by claim 151 and claims dependent therefrom.

In the present Action, the Office countered Applicants' arguments that the cited references do not disclose an "arm-first" approach to a multi-arm star copolymer by citing the addition of ethylenically unsaturated compounds to a polymer chain as shown in Scheme 3 of the '491 patent (columns 15-16). The Office states that the ethylenically unsaturated compounds can be considered core forming compounds. Applicants note that these compounds are not divinyl core forming compounds as required by the claims. Therefore, this approach cannot support *prima facie* obviousness.

The star polymers formed by these different processes (arm-first vs. step-wise) will have different characteristics. For example, step-wise addition of monomer units results in a star polymer with atom transferable units (i.e., X) at the terminus of each arm at the periphery of the polymer, whereas the arm termini of the arm-first approach can have different functionality (or no functionality) (see, page 36, line 15 to page 39, line 6 of the application as filed). Also, because the polymer "arms" have been pre-formed in the arm-first approach, the claimed process allows greater control over the functionality on the arm terminus, the molecular weight of each arm, and the molecular weight distribution of each arm. The prior art approaches do not possess this control element, nor are these elements obviously controllable using the step-wise approach. Further, the arm-first process of the subject application has the advantage of having transferable atoms within the core of the molecule which can be used for the polymerization of a second set of arms using a different monomer to prepare a mikto-arm type star polymer (see page 37, line 28 to page 38, line 2). The arms of the mikto-type star polymer will have different physiologies and allow dispersion in solvents of different polarity. In addition, the presence of a transferable atom within the core of the molecule may be

used to initiate star-star coupling as seen in Scheme 5, page 36. Star polymers formed by a step-wise approach will have none of these features.

One having ordinary skill in the art would not be motivated by the disclosure of the '491 patent or Patten to form a multi-arm star copolymer by an "arm-first" process comprising reacting polymer chains having a radically transferable atom or group with a divinyl core forming compound. Further, neither the '491 patent nor Patten teach or disclose a divinyl core forming compound. Therefore, *prima facie* obviousness has not been established and the cited references cannot render obvious the processes of claims 151-158. Applicants respectfully request that the rejection under 35 U.S.C. § 103(a) be withdrawn.

New Claim 289

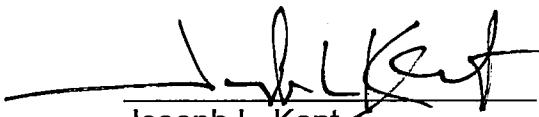
New claim 289 discloses a controlled polymerization process for the production of telefunctional multi-arm star copolymers. The process includes adding a second compound comprising a first desired functional group to the end of a telefunctional multi-arm star initiator comprising radically transferable atoms or groups. Neither the Matyjaszewski patents nor the Patten reference teach or suggest the claimed subject matter. Therefore, new claim 289 is novel and non-obvious over the cited references.

CONCLUSION

Applicants submit that claims 86-87, 90-92, 94-139, 151, 152, 154-158 and 289 of the subject application recite novel and non-obvious processes for forming polymers. Applicants respectfully request that the Examiner consider the Amendments and Remarks submitted herein for further examination of the subject application. Applicants submit that all claims in the subject application are in condition for allowance. Accordingly, reconsideration of the rejections and allowance of all pending claims is earnestly solicited.

If the undersigned can be of assistance to the Examiner in addressing issues to advance the application to allowance, please contact the undersigned at the number set forth below.

Respectfully submitted,



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